



Article

Transportation Asset Management Decision Support Tools: Computational Complexity, Transparency, and Realism [†]

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[†] This paper was presented at the second international conference on constructed infrastructure facilities (ma2infra2) in Honolulu, 16–19 August 2023. It has been selected for publication in this journal.

Abstract: Asset management decision support tools determine which action (maintenance, rehabilitation, or reconstruction) is applied to each facility in a transportation network and when. Sophisticated tools recognize uncertainties and consider emerging priorities. However, these tools are often computationally complex and lack transparency; the models are difficult to evaluate, and the outputs are challenging to validate. This paper explores computational complexity, transparency, and realism in transportation asset management decision support tools to better understand how to select the right tools for a particular context. Descriptions of how state departments of transportation in the United States make use of optimization in their mandated transportation asset management plans to make decisions are used to understand the needs of states. This qualitative analysis serves as a review of the goals and practices of state agencies. An existing asset management tool is then used to demonstrate the tradeoffs involved in accurately capturing the decision-making process and complexity. The results provide examples of strategies that agencies can use when selecting decision support tools and for researchers and tool developers working toward developing the right tool for an application.

Keywords: asset management; decision support; computational complexity; transparency; validation



Citation: Atolagbe, B.; McNeil, S. Transportation Asset Management Decision Support Tools: Computational Complexity, Transparency, and Realism. *Infrastructures* **2023**, *8*, 143. <https://doi.org/10.3390/infrastructures8100143>

Academic Editor: Hsinj "David" Lee

Received: 1 September 2023

Revised: 6 October 2023

Accepted: 8 October 2023

Published: 11 October 2023



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1. Introduction

Asset management decision support tools are used by transportation agencies to determine which action (maintenance, rehabilitation, or reconstruction) is applied to each facility in a transportation network and when. These decisions are made considering the existing and predicted condition and performance, asset life cycle costs, and user costs. Sophisticated tools recognize uncertainties and consider emerging priorities, such as resilience and sustainability. However, these tools are often computationally complex and lack transparency; the models are difficult to evaluate, and the outputs are challenging to validate. As a result, true optimization tools are not widely used by state agencies in the United States.

The objective of this paper is to better understand how to select or develop the right tools for a particular context. To address this objective, three questions are posed: (1) How are different tools characterized? (2) How are different contexts characterized? (3) What criteria can be used to select the right tool? In answering these questions, this paper explores computational complexity, transparency, and realism in asset management decision support tools. The analysis and results are intended to provide examples of strategies that agencies can use when selecting decision support tools.

This paper reviews different types of decision support tools (ranking, prioritization, thresholds, and optimization), how tools are set up, alternative solution methods, and

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